



REGULATORY GUIDE

OFFICE OF STANDARDS DEVELOPMENT

REGULATORY GUIDE 1.137

FUEL-OIL SYSTEMS FOR STANDBY DIESEL GENERATORS

A. INTRODUCTION

General Design Criterion 17, "Electric Power Systems," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires that an onsite electric power system and an offsite electric power system be provided to permit functioning of structures, systems, and components important to safety. In addition, Criterion 17 contains requirements concerning system capacity, capability, independence, redundancy, availability, testability, and reliability. Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 establishes overall quality assurance requirements for the design, construction, and operation of structures, systems, and components important to safety. This regulatory guide describes a method acceptable to the NRC staff for complying with the Commission's regulations regarding fuel-oil systems for standby diesel generators and assurance of adequate fuel-oil quality. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

B. DISCUSSION

Working Group ANS-59.51 of Subcommittee ANS-50, Nuclear Power Plant Systems Engineering, of the American National Standards Committee N18, Nuclear Design Criteria, has prepared a standard that provides design requirements for the fuel-oil systems for standby diesel generators. This standard was approved by the American National Standards Committee N18 and its Secretariat, and it was subsequently approved and designated ANSI N195-1976 by the American National Standards Institute on April 12, 1976.

For proper operation of the standby diesel generators, it is necessary to ensure the proper quality of the fuel oil. Appendix B to ANSI N195-1976 addresses the recommended fuel-oil practices. Although not a mandatory part of the standard, the staff believes Appendix B can serve as an acceptable basis for a program to maintain the quality of fuel oil, as supplemented by regulatory position 2 of this guide.

* Lines indicate substantive changes from previous issue.

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Comments and suggestions for improvements in these guides are encouraged at all times, and guides will be revised, as appropriate, to accommodate comments and to reflect new information or experience. This guide was revised as a result of substantive comments received from the public and additional staff review.

C. REGULATORY POSITION

1. The requirements for the design of fuel-oil systems for diesel generators that provide standby electrical power for a nuclear power plant that are included in ANSI N195-1976, "Fuel Oil Systems for Standby Diesel-Generators,"¹ provide a method acceptable to the NRC staff for complying with the pertinent requirements of General Design Criterion 17 of Appendix A to 10 CFR Part 50, subject to the following:

a. Throughout ANSI N195-1976, other documents required to be included as part of the standard are either identified at the point of reference or described in Section 7.4, "Applicable Codes, Standards, and Regulations," or in Section 11, "References," of the standard. The specific acceptability of these listed documents has been or will be addressed separately in other regulatory guides or in Commission regulations, where appropriate.

b. Section 1, "Scope," of ANSI N195-1976 states that the standard provides the design requirements for the fuel-oil system for standby diesel generators and that it sets forth other specific design requirements such as safety class, materials, physical arrangement, and applicable codes and regulations. The standard does not specifically address quality assurance, and in this regard ANSI N195-1976 should be used in conjunction with Regulatory Guide 1.28, "Quality Assurance Program Requirements (Design and Construction)," which endorses ANSI N45.2-1977, "Quality Assurance Program Requirements for Nuclear Power Plants," for the design, construction, and maintenance of the fuel-oil system.

c. Section 5.4, "Calculation of Fuel Oil Storage Requirements," of the standard sets forth two methods for the calculation of fuel-oil storage requirements. These two methods are (1) calculations based on the assumption that the diesel generator operates continuously for 7 days at its rated capacity, and (2) calculations based on the time-dependent

¹Copies may be obtained from the American Nuclear Society, 555 North Kensington Avenue, La Grange Park, Illinois 60525.

Comments should be sent to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch.

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loads of the diesel generator. For the time-dependent load method, the minimum required capacity should include the capacity to power the engineered safety features.

d. Section 7.3, "Physical Arrangement," of ANSI N195-1976 states that "the location of day tanks shall be as required by the diesel-engine manufacturer." In addition to this requirement, the physical location of the day tank relative to the engine and design of the engine fuel system should take into account such items as net positive suction head requirements and the potential need for electric fuel pumps powered from a reliable power supply to ensure that the diesel-generator unit can start automatically and attain the required voltage and frequency within acceptable limits and time.

e. Section 7.3 of ANSI N195-1976 states that the arrangement of the fuel-oil system "shall provide for inservice inspection and testing in accordance with ASME Boiler and Pressure Vessel Code, Section XI, 'Rules for Inservice Inspection of Nuclear Power Plant Components.'" For those portions of the fuel-oil systems for standby diesel generators that are designed to Section III, Subsection ND of the Code, an acceptable method of meeting the requirements of Section 7.3 is to ensure that the system arrangement would allow:

(1) Pressure testing of the fuel-oil system to a pressure 1.10 times the system design pressure at 10-year intervals. In the case of storage tanks, recommendations of the tank vendor should be taken into account when establishing the test pressure.

(2) A visual examination to be conducted during the pressure test for evidence of component leakages, structural distress, or corrosion. In the case of buried components, a loss of system pressure during the test constitutes evidence of component leakage.

f. Section 7.3 of ANSI N195-1976 requires that adequate heating be provided for the fuel-oil system. Assurance should be provided that the fuel oil can be supplied and ignited at all times under the most severe environmental conditions expected at the facility. This may be accomplished by use of an oil with a "cloud point" lower than the 3-hour minimum soak temperature² expected at the site during the seasonal periods in which the oil is to be used, and/or by maintenance of the onsite fuel oil above the "cloud point" temperature.

g. Section 7.5, "Other Requirements," of the standard states that "protection against external and internal corrosion shall be provided" for the fuel-oil system. To amplify this requirement for buried supply tanks not located within a vault and other buried portions of the system, a protective coating and an impressed current-type cathodic protection system should be provided in accordance with NACE Standard RP-01-69 (1972 Revision), "Recommended

²J.P. Doner, "A Predictive Study for Defining Limiting Temperatures and their Application in Petroleum Product Specifications," U.S. Army, Mobility Equipment Research and Development Center, Coating and Chemical Laboratory, Aberdeen Proving Ground, Maryland, CCL Report No. 316.

Practice—Control of External Corrosion on Underground or Submerged Metallic Piping Systems."³ In addition, the impressed current-type cathodic protection system should be designed to prevent the ignition of combustible vapors or fuel oil present in the fuel-oil systems for standby diesel generators.

h. Section 7.5 of the standard includes requirements for fire protection for the diesel-generator fuel-oil system. The requirements of Section 7.5 are not considered a part of this regulatory guide since this subject is addressed separately in more detail in other NRC documents. Thus a commitment to follow this regulatory guide does not imply a commitment to follow the requirements of Section 7.5 concerning fire protection.

2. Appendix B to ANSI N195-1976 should be used as a basis for a program to ensure the initial and continuing quality of fuel oil as supplemented by the following:

a. The oil stored in the fuel-oil supply tank, and the oil to be used for filling or refilling the supply tank, should meet the requirements of Federal Fuel Oil Specification VV-F-800b (April 2, 1975); ASTM D975-77, "Standard Specification for Diesel Fuel Oils;" or the requirements of the diesel-generator manufacturer, if they are more restrictive, as well as the fuel-oil total insolubles level specified in Appendix B to the standard. The "cloud point" should be less than or equal to the 3-hour minimum soak temperature² or the minimum temperature at which the fuel oil will be maintained during the period of time that it will be stored. If test results for viscosity or for water and sediment for fuel oil contained in the supply tanks exceed the limits specified in the applicable specification, the diesel should be considered inoperable. Fuel oil contained in the supply tank not meeting remaining applicable specification requirements should be replaced in a short period of time (about a week).

b. Prior to adding new fuel oil to the supply tanks, onsite samples of the fuel oil should be taken. As a minimum, prior to the addition of new fuel, tests for the following properties should be conducted:

- (1) Specific or API gravity
- (2) Water and sediment
- (3) Viscosity

Test results for the latter two tests should not exceed the limits specified in the applicable specification. Analysis of the other properties of the fuel oil listed in the applicable specification should be completed within 2 weeks of the addition.

c. The periodic sampling procedure for the fuel oil should be in accordance with ASTM D270-1975, "Standard Method of Sampling Petroleum and Petroleum Products."⁴

³Copies may be obtained from the National Association of Corrosion Engineers, 2400 West Loop South, Houston, Texas 77027.

⁴Also designated ANSI Z11.33-1976. Copies may be obtained from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

d. Accumulated condensate should be removed from storage tanks on a quarterly basis or on a monthly basis when it is suspected or known that the groundwater table is equal to or higher than the bottom of buried storage tanks.

e. Day tanks and integral tanks should be checked for water monthly, as a minimum, and after each operation of the diesel where the period of operation was 1 hour or longer. Accumulated water should be removed immediately. If it is suspected that water has entered the suction piping from the day or integral tank, the entire fuel-oil system between the day or integral tank and the injectors should be flushed.

f. As a minimum, the fuel oil stored in the supply tanks should be removed, the accumulated sediment removed, and the tanks cleaned at 10-year intervals. To preclude the introduction of surfactants in the fuel system, this cleaning should be accomplished using sodium hypochlorite solutions or their equivalent rather than soap or detergents.

g. If an event should occur that would require replenishment of fuel oil without the interruption of operation of the diesel generators, the method of adding fuel oil should be such as to minimize the creation of turbulence of the accumulated residual sediment in the bottom of the supply tank since stirring up this sediment during the addition of acceptable new incoming fuel has the potential of causing the overall quality of the fuel oil in the storage tank to become unacceptable.

h. For those facilities having an impressed current-type cathodic protection system, cathodic protection surveillance should be conducted according to the following procedures:

(1) At intervals not exceeding 12 months, tests should be conducted on each underground cathodic protection system to determine whether the protection is adequate.

(2) The test leads required for cathodic protection should be maintained in such a condition that electrical measurements can be obtained to ensure the system is adequately protected.

(3) At intervals not exceeding 2 months, each of the cathodic protection rectifiers should be inspected.

(4) Records of each inspection and test should be maintained over the life of the facility to assist in evaluating the extent of degradation of the corrosion protection systems.

D. IMPLEMENTATION

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used in the evaluation of all (1) construction permit applications, (2) standard reference system preliminary design applications (PDA) or Type-2 final design applications (FDA-2), and (3) licenses to manufacture that are docketed after November 1, 1979, except those portions of a construction permit application that:

a. Reference an approved standard reference system preliminary or final design (PDA or FDA) or an application for such approval.

b. Reference an approved standard duplicate plant preliminary or final design (PDDA or FDDA).

c. Reference parts of a base plant design qualified and approved for replication.

d. Reference a plant design approved or under review for approval for manufacture under a Manufacturing License, or applications for such approval.